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## CONSERVATION IN THEORY AND PRACTICE<sup>1</sup>

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More than one speaker, I suspect, has submitted a title under stress, and then when the grim business of preparation began, has opened his dictionary to see exactly what he is to talk about. Following this precedent, I find half a dozen meanings for the word "theory," and more than three times as many for the word "practice." Curiously, I find, too, that when these words are used together, it is in an antagonistic sense. In such instances it is the word "theory" which suffers, for it is used to mean—not a body of principles—but speculation and guesswork. Since our civilization accepts the achievement of power, whether social, political, or economic, as a practical accomplishment and a commendable one, any criticism or opposition can be damned out of hand as being theoretical, speculative, irresponsible, and visionary. Not to be practical in the accepted sense can be a very bad thing indeed, and to call anyone a theorist seems to dispose of him effectively.

For a long time those excellent fellows, the sport fishermen, were convinced that poor fishing could be remedied by closed seasons, catch limits, and the breeding of fish in hatcheries. Any suggestion to the contrary was dismissed as theory. Then gradually fishermen began to learn of the importance of clean water as a habitat for fish, of the enormous reproductive power of fish in good environment, and of the extent to which our inland waters have been polluted by sewage, industrial waste, and silt from eroding farm lands.

The resulting protest has taken on the character of a minor political earthquake. Sportsmen have mobilized to demand that our rivers and lakes be made clear again. Now this is an expensive request to those who have so long used our streams as open sewers. As a matter of fact they have a reasonable and honorable defense, for the public which has so long tolerated this abuse is as guilty as they and should be made to shoulder part of the burden. But the interesting fact is that in the heat of battle the first defense was to reach for a deadly weapon—the word "theory." The fishermen who demanded an end to pollution were called "theorists," although they include men from all walks of life. It was amusing to see, in the newspapers, a fair cross-section of our population thus labelled, on the bland assumption that if you call a man a "theorist" you are effectively rid of him.

Even those who should know better fall for this. I recall a congressman who had considerable respect for science. One day he asked me point blank if it would not be a good thing to prohibit the growing of wheat in the semi-arid country west of the 100th meridian where the Dust-bowl lies. Knowing the mischief which had resulted from this practice, it was a great temptation to say "Yes, of course" and have done with it. But as a scientist I was familiar with the diversity of soils and other conditions in this area. In all honesty, I had to qualify my answer. Unfortunately my host was not a scientist. He was a politician, though an enlightened one. He couldn't be bothered with details, however simply they were

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presented. He wanted an answer in the good Christian tradition of "Yea, yea, and nay, nay," and held forth at length on the need for a lexicon which would translate science into black and white for the benefit of his kind.

Now this particular congressman had performed a considerable public service by coining the word "gobbledegook" in protest against the obscure and pretentious language that had recently become so popular in government documents—"directives," "implementations," and the like. But there is a vast difference between inflated, involved, and misleading language and the plain description of a complicated scientific situation. For all his good intentions my friend was too impatient to make the distinction. In objecting to scientists not because their theories were wrong, but because they were too complex, he allied himself with his political enemies who would gladly discredit theory because the truth might interfere with their personal schemes.

It is a curious fact that while the average man can be readily prejudiced against theory as something impractical and speculative, he has a great appetite for speculation, and a great weakness for speculative theories as a guide in his most common actions. Countless millions have shaped their conduct and established their values in conformity with intuitive systems of belief which not only have not been, but cannot be, tested with the same simple rigor that applies to scientific theory.

Even that most ruthlessly practical and realistic of conquerors, Ghenghis Khan, who tolerated all religious faiths among those spared by his sword, considered it necessary to formulate a system which he called the Yassa—some twenty-two statements of spiritual and practical belief. The activities of Hitler along this line are too recent to require description, and were carried to the absurd point where they ultimately crippled vital scientific research in Germany. Even Soviet Russia, which has exalted science into a religion, is allowing the party line to determine what is true and false in genetics, to say nothing of art and literature. By this view biological truth is no longer a matter of open inquiry and free agreement among scientists of all nations. To my mind this is the most tragic and decisive symptom of a barrier between East and West. If the same kind of nonsense spread to the physical sciences, we would benefit by the resulting paralysis in Russia, as we did in the case of Hitler, but I doubt if the Kremlin will go that far.

Actually there are signs of a reaction against science in our own civilization. Certainly there is revolt against scientists and scientism. It began some years ago in England with the proposal for a science holiday, to permit society to catch up with technological change. It has been continued vigorously by Hutchins and his disciples in the Great Books movement. True, Hutchins does insist on human values and the need for intelligence, and he has given ample financial support to scientific research at Chicago. But he has some of the qualities of a highly literate, sharp-tongued, and extremely clever demagogue. Within the month I heard him condemn the social scientists for teaching trash; and when asked what he meant by trash, he replied "facts!"

On the best-seller list just now is Standen's new book, "Science is a Sacred Cow"—another hint of the gathering reaction. With devastating flippancy it points out the limitations of science and of scientists. This is an oft-told tale which the scientist can well afford to read again. But if it coddles the popular delusion that there are short cuts to natural truths, it can do mischief. I must admit that there are scientists who are uneducated, unaware of their premises, naive in their notions of method and of truth. But this will hardly stand as a mass indictment, with physicists, for example, concerned as they are at the use to which their discoveries have been put.

If the practical man has a contempt for theory I suspect it to be a front for his fear, and the more vehement his expression of contempt, the greater his fear of

the power which lies in theory. Assuredly there is no more powerful agency at man's disposal than theory. Theory is something to be afraid of, unless it favors his immediate schemes.

The practical man, of course, is glad to use such bits of theory as he needs for his purpose. I once met a gentleman who has on his payroll some of the ablest theorists in the country—he cannot do without them. But I found him quite uninterested in discussing an ancestor of his who had some stimulating ideas on the subject of industry, agriculture and society. After all, great grandfather had raised some very uncomfortable as well as important questions.

The current wave of dam building illustrates the tendency to limit the use of theory to what seems at the time practically advantageous, while ignoring the broader aspects of theory which are not immediately convenient. The effect can be serious. Just recently two dams which seemed to comply with all the necessary requirements had to be breached to avoid the danger of disastrous floods downstream. The designer had taken no account of stream-gauge data in the watershed, though he followed the rules in everything else. A trained hydrologist fortunately caught the defect in time to save lives and property. Both men were using theory, but that of the first was too circumscribed.

I recall, with no pleasure whatsoever, being invited to a meeting to promote the Grand River dam in Oklahoma, later built at great expense. I was all in favor of keeping as much transient water in Oklahoma as possible, but took pains to explain that land-use patterns in the watershed would have to be studied, perhaps modified if the reservoir were to be kept from silting and the dam from becoming a flood menace. The promoters were much incensed and made that fact only too clear. They got rid of me, got the money, and built the dam. Since the dam was completed there has been at least one serious flood, and so much siltation that farmers are being begged to practice soil conservation. The practical boys got their dam without undue delay, but theory caught up with them. I have never seen the dam. No doubt it complies beautifully with all of the requirements of dynamic theory. But this is dismembered theory, restricted in scope and worked out without relation to the broader aspects of the problem. It is an instance of the precise application of science to detail, and the grossest empiricism with respect to the broad setting.

One may sail a lake, or skirt the edge of a coast without considering latitude and longitude. The location or even the existence of the poles and of other continents need not concern him. But when mariners venture on the broad ocean they must know that earth is a sphere and be able to locate themselves with mathematical precision on this sphere. The voyages of Columbus were quickly followed by the perfection of quadrant and chronometer, with consequent rapid advance in astronomy and physics. Theory, in truth, is not in antagonism to practice, but inseparable from it. It is on this basis that I wish to discuss theory and practice in conservation, conceiving theory not as speculation but as a body of principles.

To that end, I shall first summarize the situation that now exists with respect to our resources, then develop briefly the principles upon which any sound future action should be based.

To the Europeans who settled what is now the United States, resources seemed inexhaustible. Andrew Jackson, in one of his Thanksgiving Proclamations, said they were inexhaustible, and that we would never have unemployment. Before that, Jefferson's purchase of Louisiana had been condemned as piling too much on top of plenty, while later Alaska was to be referred to as Seward's Folly.

And it was true that some resources which today are of great value—notably trees, water, and wildlife—were honestly regarded as obstacles against civilization, to be got rid of as speedily as possible. The log-burnings so well described by Conrad Richter, the gigantic slaughter of bison during the 70's, and the reckless

drainage by ditch, roadway, and tile all stemmed from the desire to put more land to plow or pasture.

There was no restraining concept of the need for a balance of nature, least of all any notion that man might be a part of nature and thus dependent upon maintaining such a balance. Poor Richard's sayings were scripture to our young nation. But somehow we paid no heed to one of the most important and profound statements that Dr. Benjamin Franklin ever made. This philosopher had studied the rate of population increase in the colonies, anticipating Malthus by nearly fifty years. As he put it, "There is, in short, no bound to the prolific nature of plants or animals, but what is made by their crowding and interfering with each other's means of subsistence."

He failed to say "plants, animals, or men" and was perhaps too discreet to say "plants, men, and other animals." After all, Lord Monboddo's suggestion that human beings had once worn tails was considered outrageous, while the religious dogma of original sin took care of many complications which arose from the fact that our own species has a long pre-civilized and a longer prehuman past. Why call man an animal? The earth and the fulness thereof might be God's but there was a general feeling that man had full power of attorney.

The medieval Church had held that economic behavior was very much its business. Individuals guilty of usury and greed were tried in ecclesiastical courts. The Reformation changed all that, and so destroyed the chance that wanton waste of resources might eventually have come to be regarded as a spiritual offense. This is actually the position of oriental Taoist belief, which regards violence against nature and abuse of the earth as a sin, quite as much as violence against man. But the Western World had not undergone the suffering of the crowded Orient and did not realize that, sin or not, the abuse of nature would ultimately react against man in a very practical way. In theological language, it was not yet ready for this revelation. Modern science is having to supply what religious insight missed.

With the divorce of religion from economics, the accepted standards of behavior became simply an extension of the rule "Finders keepers; losers weepers." The consequence of this philosophy is shown by the history of a single word "exploitation." To begin with, this was a perfectly respectable term, as it still is among engineers. Literally it means unfolding, the turning to practical account of anything. But presently it came to mean selfish use. And today it is a pungent term of condemnation in the general mind. This is no accident. One has only to read Angie Debo's account of the frightful waste of gas and oil resulting from the early scramble for quick profits in the Southwest to know why exploitation has become an evil word. It is only fair to say that not the technicians, but those who hired them were primarily to blame.

It is hard to measure honestly what this attitude has cost us and I for one am less concerned to cry over spilt milk than to undo what mischief we can and get started on the right track. The Conservation Foundation has recently published a report to Industry which graphically appraises the present state of our resources. The same foundation is today engaged in a nationwide water survey and a world-wide report on soil. The Soil Conservation Service, Forest Service, Fish and Wildlife Service, all have marshalled disquieting figures which seem to stand up, despite some criticism.

Some of this criticism comes from surprising sources. Thus an exceptionally able senior member of one of the older scientific bureaus of the U. S. Department of Agriculture has been severely critical of our concern over soil erosion. He calls erosion a symptom rather than a cause of poor rural economy, and says, correctly enough, that erosion is only one source of soil deterioration. But by inference he disparages its importance. Because his words have been eagerly quoted by those who would play down the whole conservation movement, I think it fair to point

out that he represents a group whose word was law in scientific agriculture until the whole erosion problem blew up in their faces. Had that group been psychologically and technically prepared to meet the emergency, would two Presidents—one a Republican and the other a Democrat—have found it necessary to develop an entirely new agency—the Soil Conservation Service? I doubt it.

Among the many foresters I know, I have found only one who is complacent about our timber supply, saying, "We have plenty of trees." I am sorry to have to point out that he is a marked man in the profession, having no connection with the growing and management of forests, but close ties with those who exploit them. So far as wildlife estimates are concerned, I know of no criticism deserving attention.

Even the best of national inventories are based on aggregates of local samples, and no skill of mathematical manipulation is able to give greater accuracy than that of the original sampling. For this reason I am inclined to lay considerable stress on my own detailed observations in the field. I have worked in all but three states of the Union—Washington, Oregon, and Arizona—as well as the province of Ontario and much of Mexico.

The net result of my observations can be stated very briefly: *efficient land use, that conserves and improves the capacity of land to produce, is the exception rather than the rule.* To a trained ecologist poor land use is as obvious as the symptoms of disease to a trained physician, while good land use stands out in notable contrast. True, money is often being made from poor land use, but if so, it is at the cost of capital investment. Even so cautious an authority as Dr. Robert Salter has warned that the great increases in yield from hybrid corn are largely obtained at the cost of soil deterioration. The same statement can be made of such other cash crops as soy beans, tobacco, and cotton.

There can be no question that a marked improvement has been under way for the past fifteen years. But neither is there any question that this improvement has been most vigorous, not on the best farming lands, but on the poorer. It is the hill counties in Ohio and in the South which have taken the lead in good conservation practice, while the rich level lands of the Black Swamp and the cotton belt continue to waste away.

I can, of course, speak most definitely of Lorain County where I have been living for the past twelve years. This county receives about forty inches of rainfall per year, over 4,000 tons per acre, yet a substantial proportion of farmers are buying city water. This county has a minimum of well managed mixed legume pasture, and far too many soy bean and corn fields left bare through the winter months. There is little systematic return of organic matter to the soil, and practically no trash farming which would increase water absorption. Our studies show that pastured woodlots, with their trampled soil, suffer heavily from summer dryness. This condition is intensified by the fact that absence of undergrowth permits leaves to be blown away, instead of rotting into absorbent mulch.

We have found that about 20 per cent of the county drains directly into highway ditches. Except for the rare cases where the drainage slope is covered with improved pasture or protected woodland, this represents a heavy discount on the annual rainfall.

The streams of the county suffer from pollution and uneven flow, with resultant damage to fishing. With respect to one stream, we know that deterioration can be traced to clearing the headwater forests and thickets. Assuming this relation to be general, we have mapped woodlots and stream sources. We find some 800 woodlots (mostly grazed) and about 400 stream sources; but of this number only 36 stream sources are wooded. This is a meager 10 per cent guarantee of stable stream flow.

Such, in brief, are conditions as of today in a fairly prosperous and respectable

agricultural county which no one thinks of as marginal. In happy contrast are two noted Ohio farms, those of Louis Bromfield in Richland County, and Cosmas Blubaugh in Knox County. Both are models of intelligent ecological treatment. That of Bromfield is thoroughly analyzed and discussed in his latest book, "Out of the Earth," and I am inclined to agree with Russell Lord that this will be one of the most important agricultural publications of recent years. Bromfield has put his land to rich meadow, whose grass and legumes are used for pasture, hay, and ensilage. Corn has been eliminated and small grains confined to the necessary minimum of oats and barley required for occasional seeding of meadows. Under a new plan oats and barley are added to the ensilage, enhancing its nutrient qualities. The deep rooting meadow plants tap the subsoil minerals, while a system of rough tillage conserves moisture and organic matter. I have myself confirmed the benefits of this system to land, water, and livestock, and am prepared to accept Mr. Bromfield's statement that he is producing meat and milk at a heavy saving. Of great importance is the claim that animals and plants are far healthier than under the old system of row crops and grain farming. This statement is in accord with much testimony from other sources and deserves the most careful scientific check.

The Bromfield farm is an individual enterprise; but there are examples of community patterns of excellent land-use, long antedating the time of science. Such are the Pennsylvania Dutch farms, the Igorote terraces between Manila and Baguio, and some of the pre-Conquest areas in central Mexico, of which mere traces persist. At best these are few in number and meager in extent as compared to the general pattern of exploitation, world around. Yet they serve to show that peace between man and nature is possible.

Now these ancient systems of good land use were worked out through generations by the costliest, most painful trial and error. On the other hand Mr. Bromfield, making use of scientific insight, was able to establish a successful system in less than ten years. For those who do not understand the advantages of scientific theory over trial and error I would recommend reading first Mr. Bromfield's "Out of the Earth" and then a recent book by George Reeves called "A Man from South Dakota." Reeves, trained in journalism, a born gambler and a hard worker, went at the business of developing his South Dakota ranch as though he were playing roulette. Unquestionably he had very difficult conditions under which to work, but at the end of twenty-four years he still seems not to sense that it is possible to conquer nature only on her own terms. He had studied some science, true, but nowhere seems to have learned that any landscape, whether farm or river valley, is a great organic entity which must operate in accordance with the principles of the balance of nature. His experience is in powerful contrast to that of Mr. Bromfield.

This brings us finally to the question of what principles underlie the wise use and care of natural resources. First I should place the fact that any area with its resources and inhabitants is an expression of energy. This energy comes primarily from the sun, is fixed by green plants in the form of organic compounds, and thereafter channeled through food chains to all forms of life present. In the course of this channeling the laws of the conservation of energy apply as relentlessly as in any laboratory experiment or industrial process. It is entirely possible for a trained ecologist to judge how efficiently the energy is being transformed and used in any habitat. He can read the landscape as a banker reads a financial statement.

Let us suppose that stubble is being burned. This results in a complete release of all energy and reduction of material to inorganic state. On the other hand if plant and animal materials undergo natural decomposition countless forms of life take part in the slow, step by step release of energy. This has two consequences. Each step affords subsistence to a particular set of organisms. The more gradual

the change, the larger the number of possible niches which can be filled by appropriate forms of plant and animal life. Each in turn performs a role in relation to the whole community, changing it and in general helping better to organize it to sustain future generations of living things. One may observe this process in an abandoned field returning to forest or a neglected roadway going back to prairie.

As time goes on any area tends to build up to the point where it makes the most efficient use possible of solar energy and the raw materials of earth and air. This is the type of virgin habitat which Europeans entered when they settled North America. It is still the norm or standard towards which good land use should direct its aim. Too often, as we have seen, the effect of human occupation is to disrupt completely this chain of events and not substitute anything constructive for it.

Finally, our own species is related to the rest of nature largely through its socially sanctioned forms of behavior. It may happen, as it did with the Pennsylvania Dutch, that such behavior was arrived at through the long course of trial and error. With us, however, the problem is to modify our behavior in the light of scientific knowledge. This clearly calls for a wide understanding of the body of principles which lie back of sound land use and for making those principles a matter of social sanction. It is at this point that the scientist must enlighten those who formulate public opinion and establish standards of behavior.

Technically, these are the artists, poets, writers and publicists of our civilization, to whom falls the task of dramatizing the truth as they see it. This was the role of John Steinbeck when he wrote "Grapes of Wrath." Unfortunately, he was at least two removes from the source of truth, and while he stirred up public opinion, the net effect had more to do with reforming transient camps in California than with restoring the soil in Oklahoma, whose abuse was the physical basis of his tragedy.

Edmund Sinnott has given us a valuable clue in his presidential address to the American Association for the Advancement of Science. He spoke on the topic, "Millions of Scientists," pointing out the opportunity for widespread social participation in science. His view has been justified, for example, by co-operative land use surveys in England and this country. The process can be much more widely extended. Such co-operation in science would bring home, as nothing else can, those principles which must guide our civilization if it is to endure.

And to his suggestion I would add another, which I think is inherent in our democratic philosophy. Call it "Millions of Interpreters" if you like. As each individual comes better to understand the principles of which I have spoken, he can, without waiting for the Steinbecks, express the importance of what he knows and so play his part in molding public opinion and establishing new values.

I can testify that just such a process is now under way. Friends of the Land, the Izaak Walton League, American Forestry Association (and here in Ohio our vigorous Ohio Forestry Association), countless Garden Clubs, and many other lay organizations are learning the truth and telling it.

The conservation movement may have a long and difficult way ahead, but it has crossed the divide.